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DERWENT-ACC-NO: 1999-051698
DERWENT-WEEK: 199906

TITLE: Plasma processor for chemical vapour deposition and etching - includes
antenna fixed around power introduction window which is also provided with
another movable antenna for cleaning
INVENTOR-NAME:
PRIORITY-DATA: 1997JP-0126514 (April 30, 1997)
PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 10302997 A	November 13, 1998	N/A	021	H05H 001/46

INT-CL_(IPC): C23C016/50; C23F004/00 ; H01L021/205 ; H01L021/3065 ;
H01L021/31 ; H05H001/46
ABSTRACTED-PUB-NO: JP10302997A
BASIC-ABSTRACT: The processor includes an antenna (18) fixed around a power
introduction window (12). Another antenna (19) is provided movably with
respect to the window. During processing, the antenna (19) is released from
the window. During cleaning, the antenna (19) approaches the window and makes
electrical contact with the antenna (18).

ADVANTAGE - Shortens plasma treatment time and discharge container cleaning
time. Improves plasma formation efficiency.

* NOTICES *

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2.**** shows the word which can not be translated.
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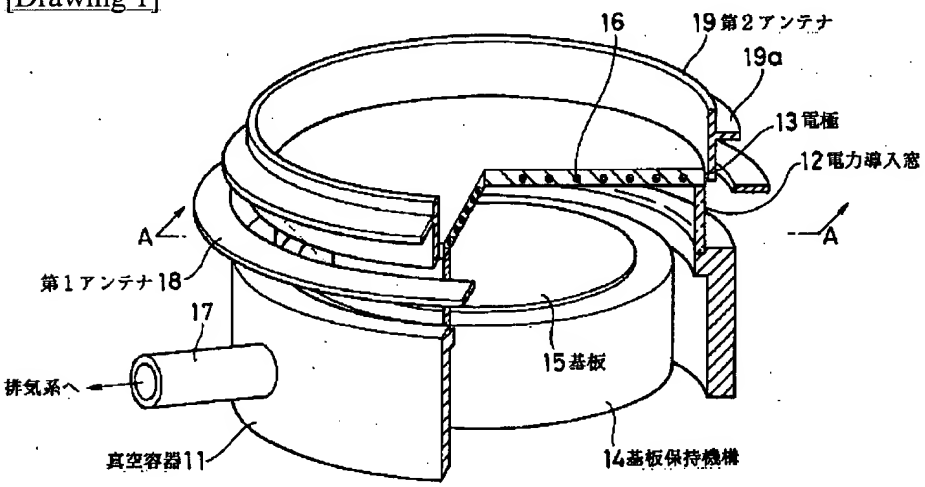
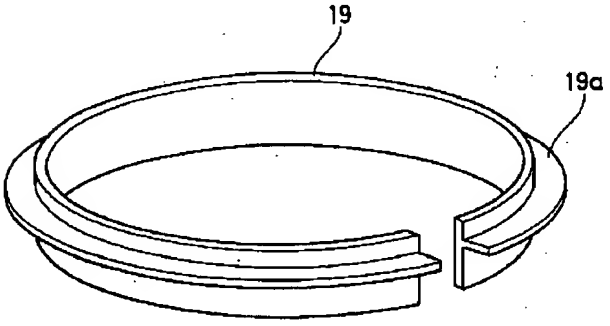
DRAWINGS

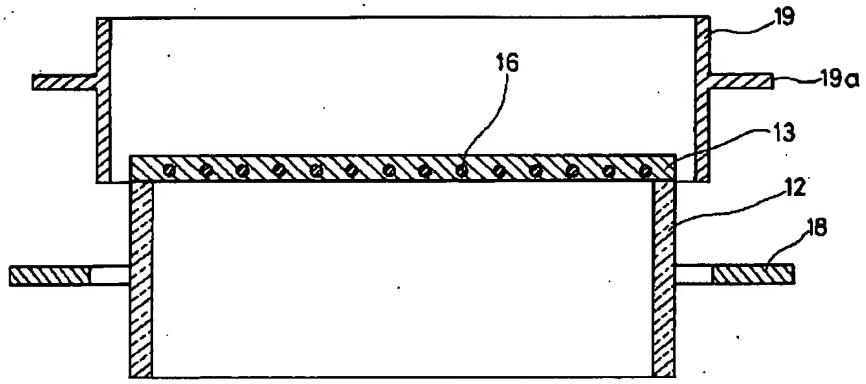
[Drawing 1]



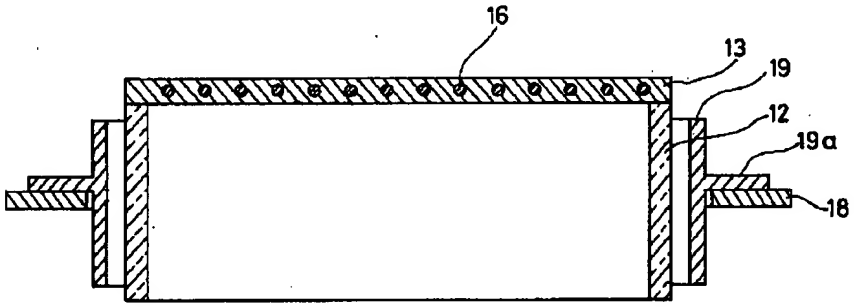
[Drawing 2]



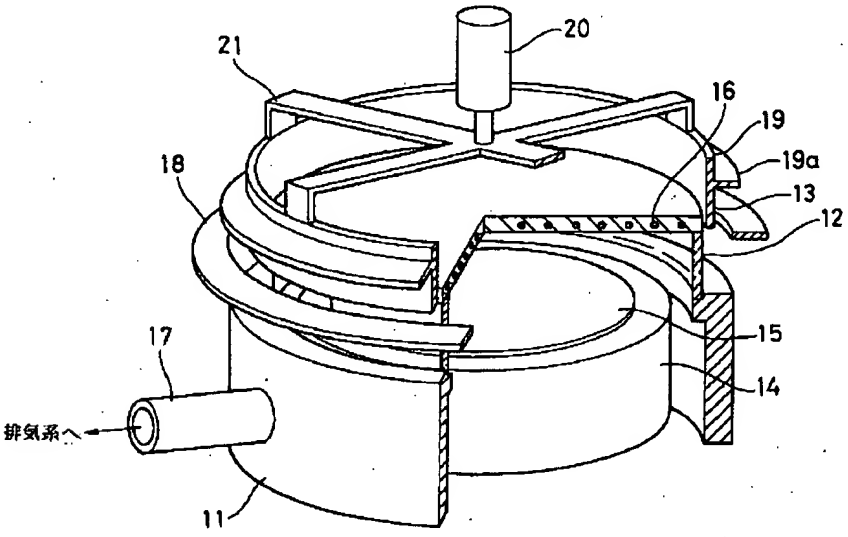
[Drawing 3]



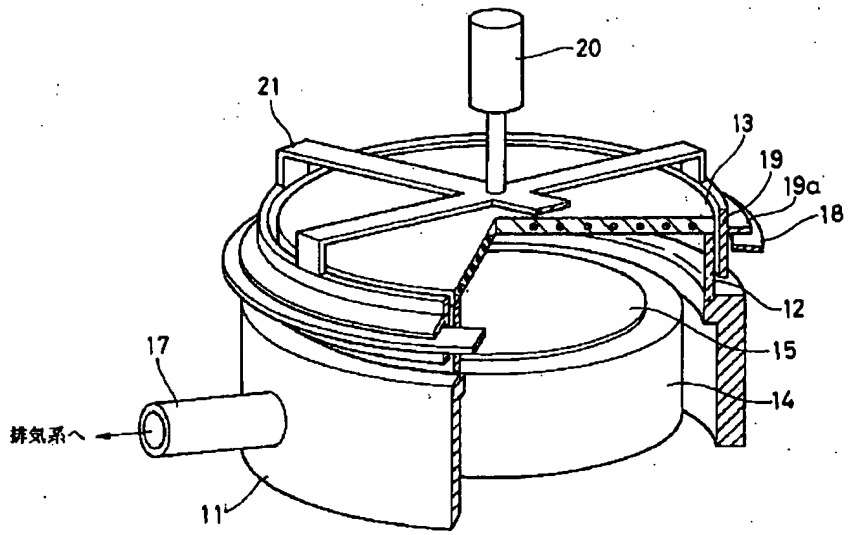
[Drawing 4]



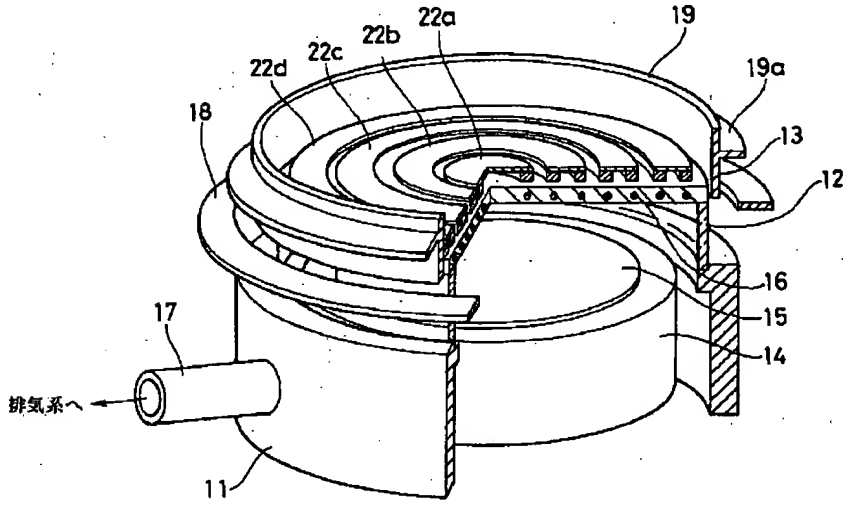
[Drawing 5]



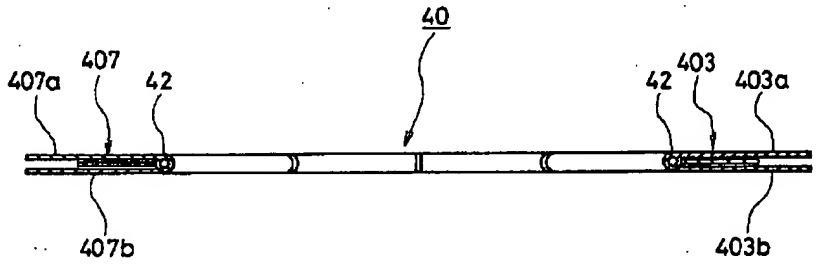
[Drawing 6]



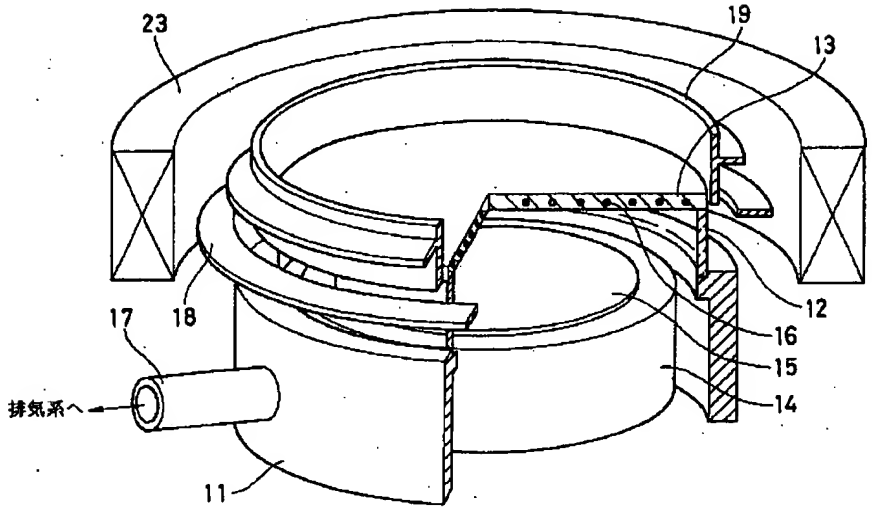
[Drawing 7]



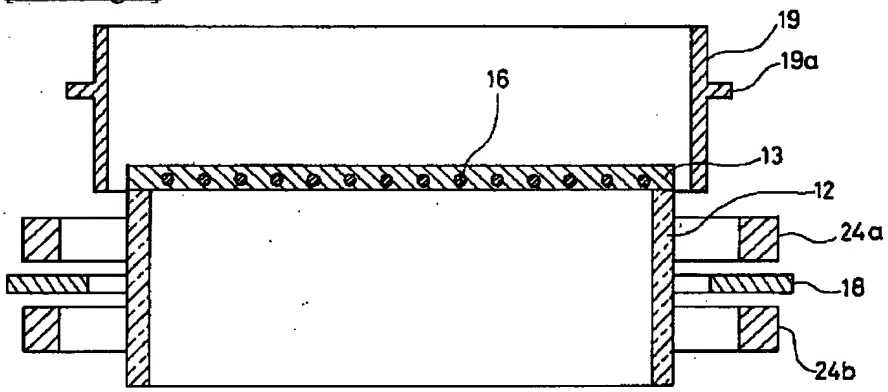
[Drawing 15]



[Drawing 8]



[Drawing 9]



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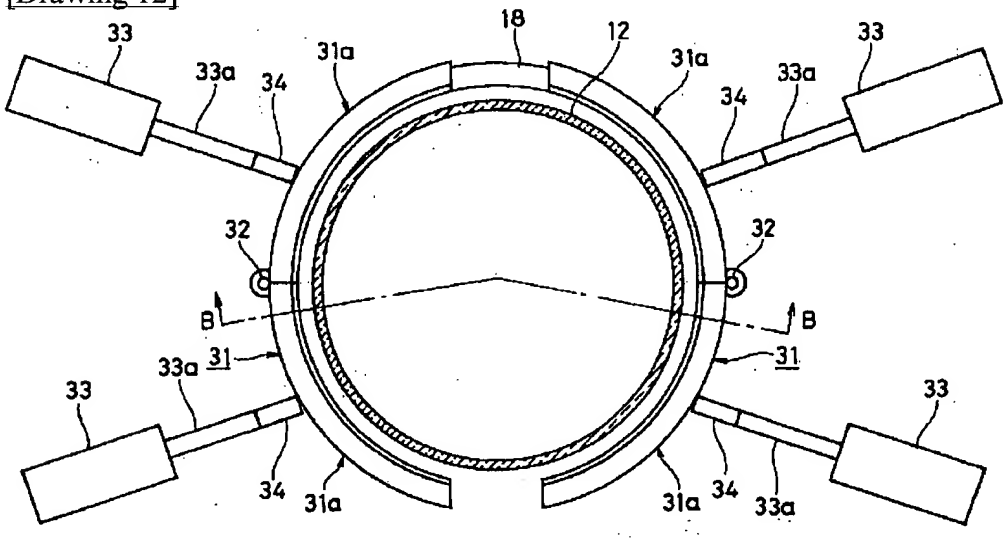
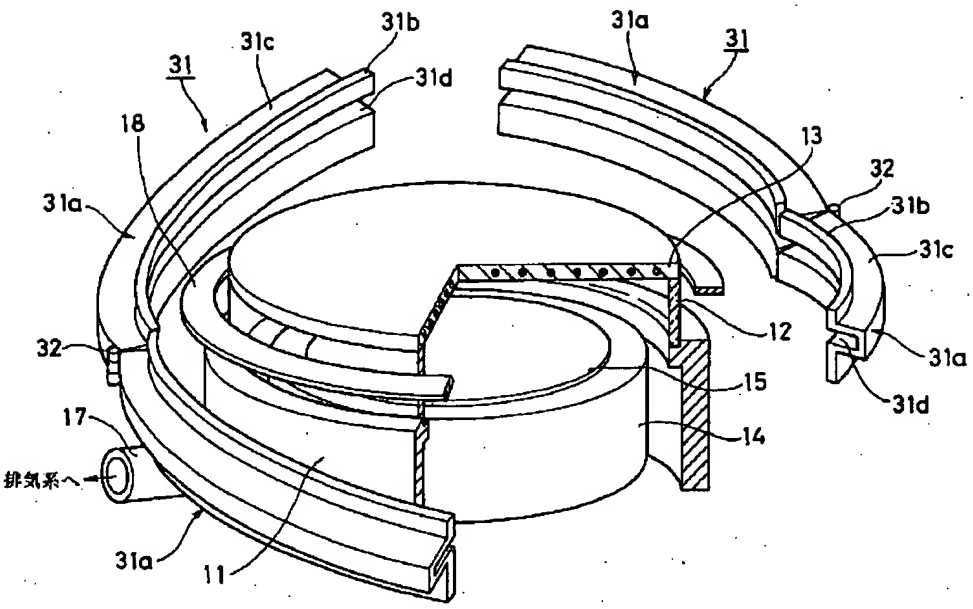
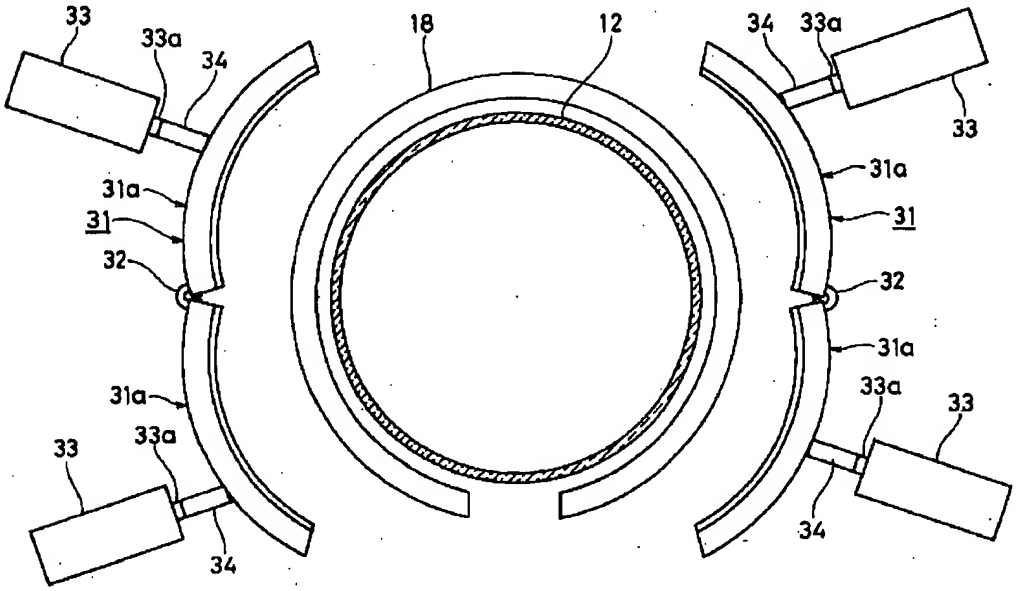


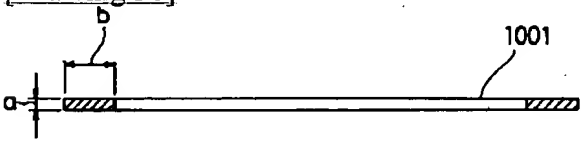
[Drawing 10]



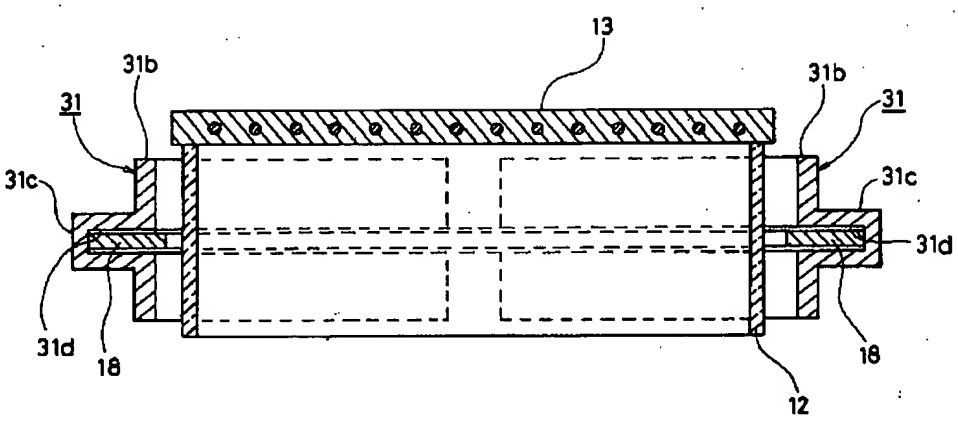
[Drawing 11]



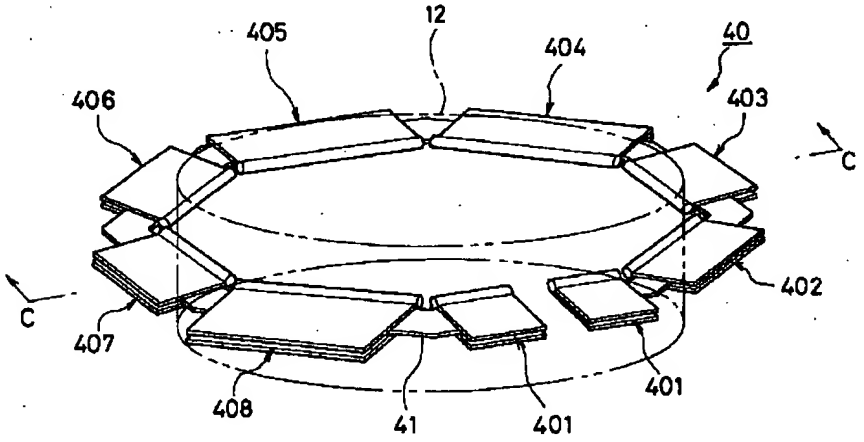
[Drawing 28]



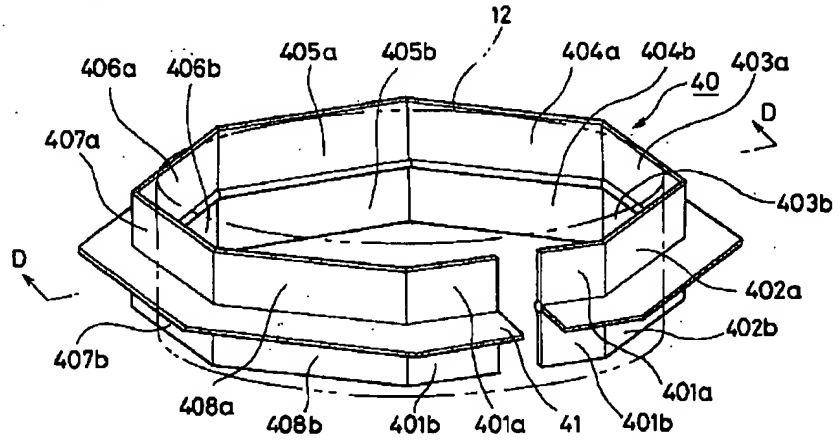
[Drawing 13]



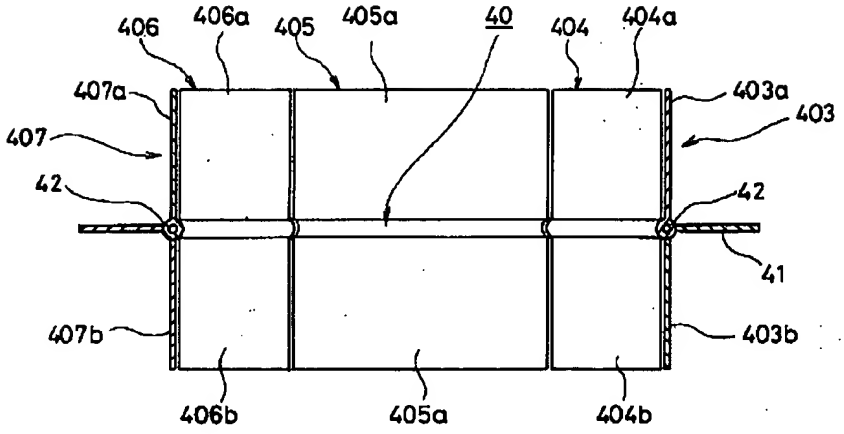
[Drawing 14]



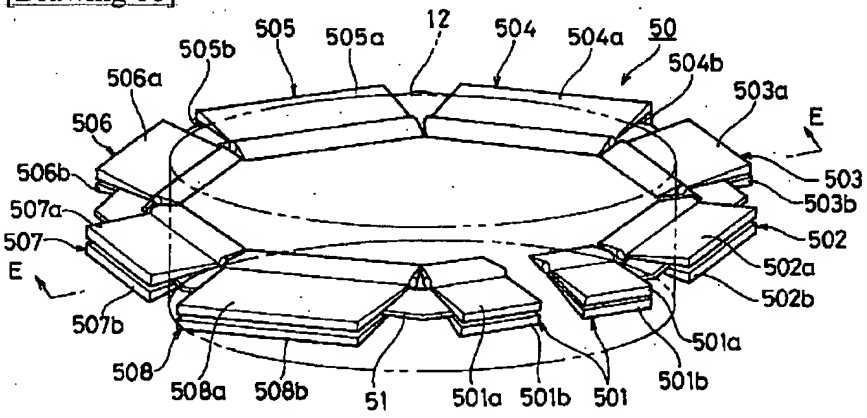
[Drawing 16]



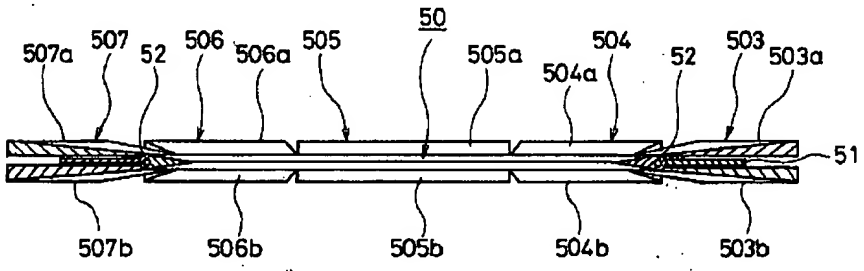
[Drawing 17]



[Drawing 18]



[Drawing 19]



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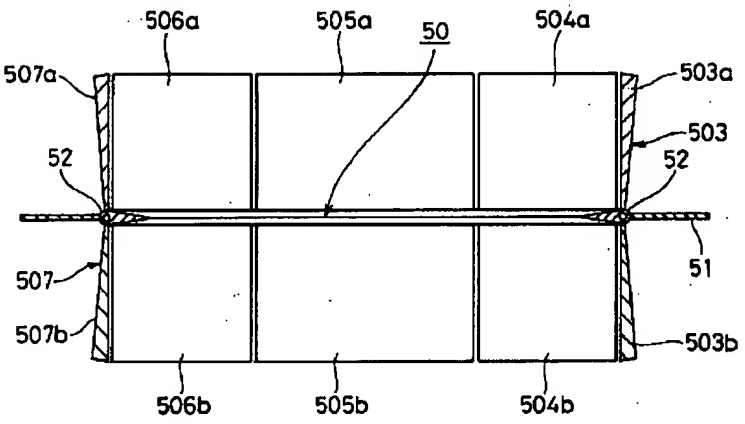
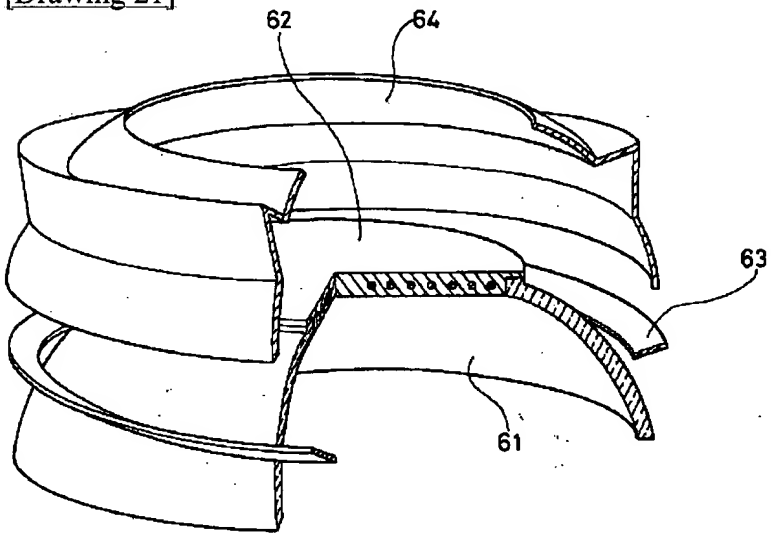
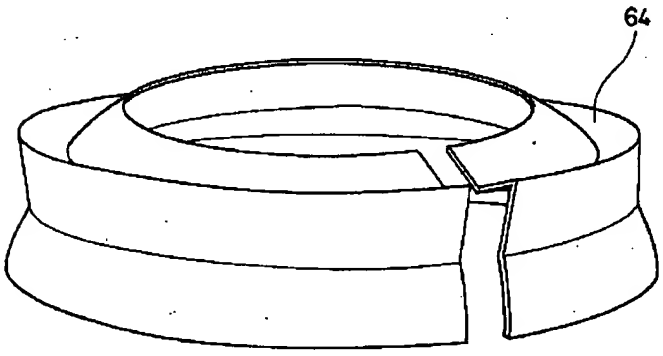


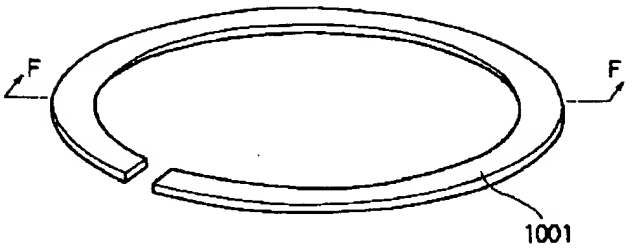
[Drawing 21]



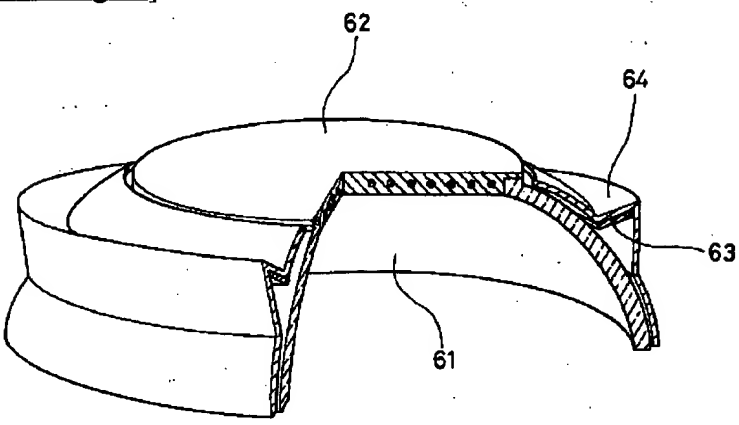
[Drawing 22]



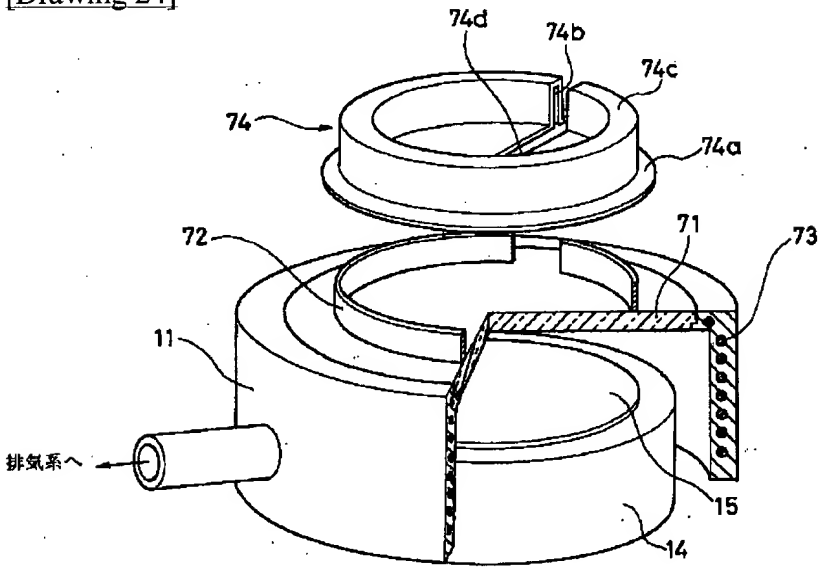
[Drawing 27]



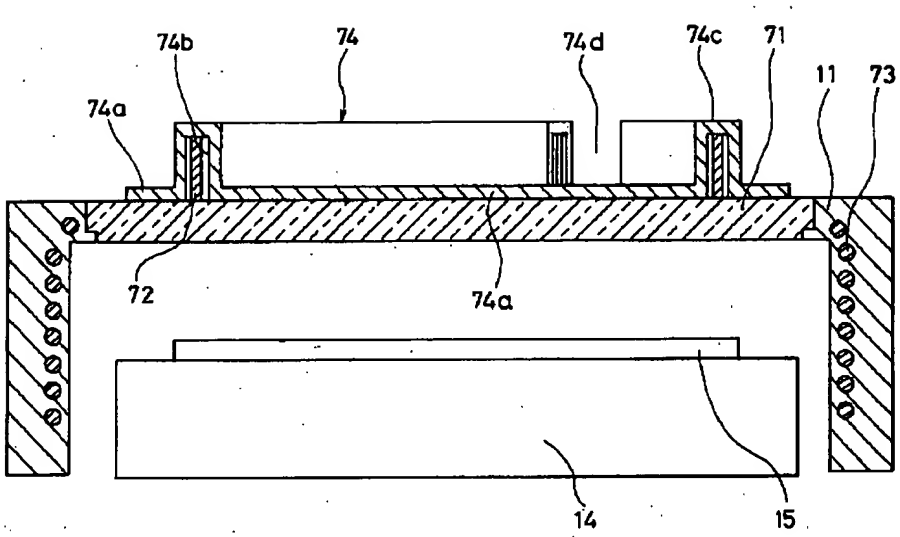
[Drawing 23]



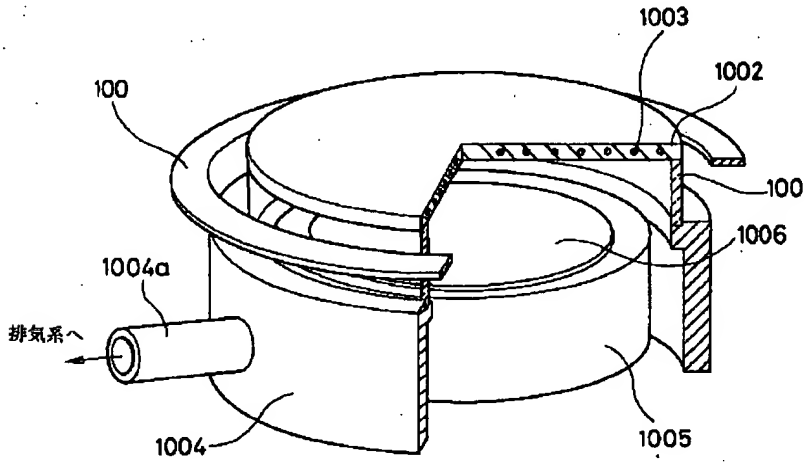
[Drawing 24]



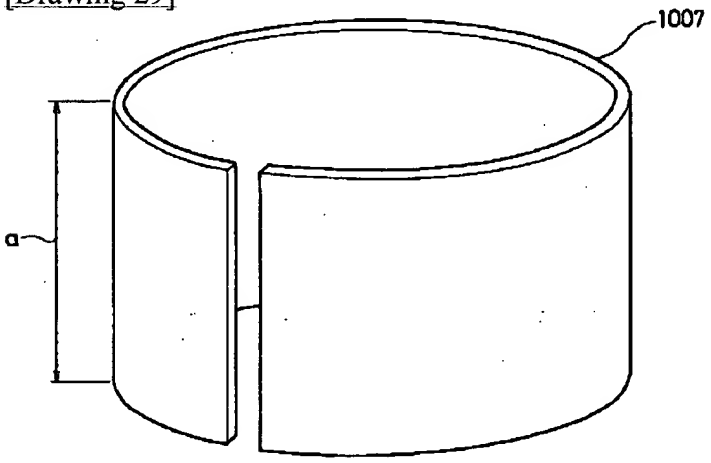
[Drawing 25]



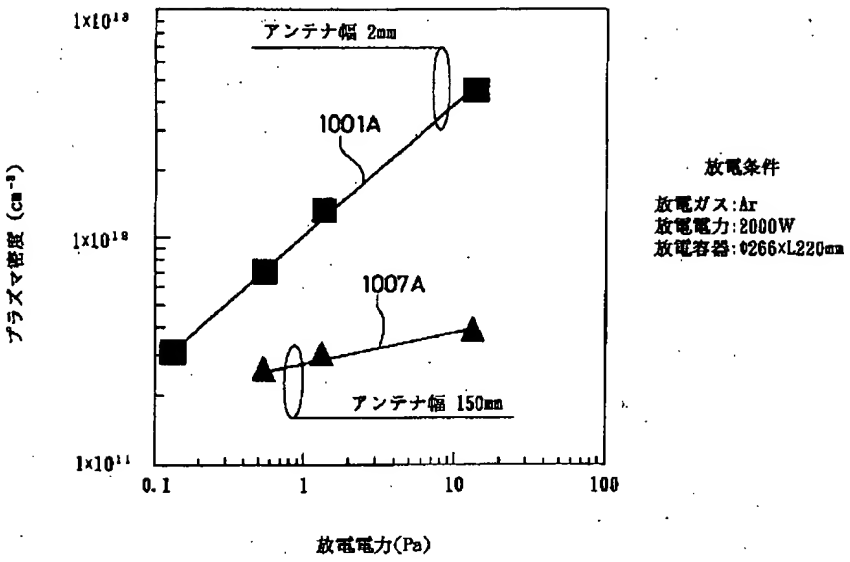
[Drawing 26]



[Drawing 29]



[Drawing 30]



[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] The electric discharge container which consists of an electrode which stopped the end of a power introduction aperture and this power introduction aperture. The aforementioned electric discharge container and the vacuum housing opened for free passage. The plasma production mechanism in which plasma is generated with the aforementioned electric discharge container. The exhaust air mechanism which maintains the interior of the aforementioned vacuum housing at a reduced pressure state. The gas introduction mechanism which introduces reactant gas into the interior of the aforementioned vacuum housing, and the substrate maintenance mechanism which opens a predetermined interval to the aforementioned electrode, is made to approach the building envelope of the aforementioned electric discharge container, and is installed in the aforementioned vacuum housing. It is plasma treatment equipment equipped with the above. the aforementioned plasma production mechanism The 1st antenna for processes with a small antenna area fixed to the circumference of the aforementioned power introduction aperture, It has the 2nd antenna for large cleaning of the antenna area prepared free [movement] to the aforementioned power introduction aperture. the 2nd antenna of the above At the time of a process, it separates from the aforementioned power introduction aperture, and the aforementioned power introduction aperture is approached at the time of cleaning, and it is characterized by contacting the 1st antenna of the above electrically.
[Claim 2] The aforementioned power introduction aperture is a cartridge substantially, and the 1st antenna of the above is substantially annular. When [at which the 2nd antenna of the above has the annular section in a periphery side] it is a cartridge-like substantially, the 2nd antenna of the above is freely movable to the shaft orientations of the aforementioned power introduction aperture and the 2nd antenna of the above approaches the aforementioned power introduction aperture, The 2nd antenna of the above is plasma treatment equipment according to claim 1 characterized by being constituted so that it may be inserted between the aforementioned power introduction aperture and the 1st antenna of the above and the aforementioned annular section may contact the 1st antenna of the above.
[Claim 3] The aforementioned power introduction aperture is a cartridge substantially, and the 1st antenna of the above is substantially annular. the 2nd antenna of the above When it can consist of a wall which makes a big antenna area, and an outside lobe which forms the slot which holds the 1st antenna of the above in the inside side of this wall, and it can move in the direction of a path of the aforementioned power introduction aperture freely and the 2nd antenna of the above approaches the aforementioned power introduction aperture, The 1st antenna of the above is plasma treatment equipment according to claim 1 characterized by being constituted so that it may hold in the aforementioned slot of the 2nd antenna of the above in the state of contact and the aforementioned wall may counter the aforementioned power introduction aperture.
[Claim 4] The aforementioned power introduction aperture is a semi-sphere configuration or its part substantially, and the 1st antenna of the above is substantially annular. the 2nd antenna of the above When it has a semi-sphere configuration or some of its configurations substantially, and it can move in the vertical direction freely to the aforementioned power introduction aperture and the 2nd antenna of

the above approaches the aforementioned power introduction aperture, The 2nd antenna of the above is plasma treatment equipment according to claim 1 characterized by being constituted so that the aforementioned power introduction aperture may be covered and the part may contact the 1st antenna of the above.

[Claim 5] A vacuum housing equipped with a plate-like power introduction aperture. The plasma production mechanism in which plasma is generated within the aforementioned vacuum housing. The exhaust air mechanism which maintains the interior of the aforementioned vacuum housing at a reduced pressure state. The gas introduction mechanism which introduces reactant gas into the interior of the aforementioned vacuum housing. The substrate maintenance mechanism which is made to approach an electric discharge field and is installed in the aforementioned vacuum housing. It is plasma treatment equipment equipped with the above, the aforementioned plasma production mechanism has the 1st antenna and the 2nd antenna, and the 1st antenna of the above is substantially annular. the 2nd antenna of the above It consists of the monotonous section which covers the aforementioned power introduction aperture, and an outside lobe which forms the circular-sulcus section which holds the 1st antenna of the above in the opposite side of this monotonous section. When it can move in the direction which intersects perpendicularly with the aforementioned power introduction aperture freely and the 2nd antenna of the above approaches the aforementioned power introduction aperture, it is characterized by being constituted so that the 1st antenna of the above may be held in the aforementioned slot of the 2nd antenna of the above in the state of contact and the aforementioned monotonous section may counter the aforementioned power introduction aperture.

[Claim 6] The electric discharge container which consists of an electrode which stopped the end of a power introduction aperture and this power introduction aperture. The aforementioned electric discharge container and the vacuum housing opened for free passage. The plasma production mechanism equipped with the antenna which generates plasma with the aforementioned electric discharge container. The exhaust air mechanism which maintains the interior of the aforementioned vacuum housing at a reduced pressure state. The gas introduction mechanism which introduces reactant gas into the interior of the aforementioned vacuum housing, and the substrate maintenance mechanism which opens a predetermined interval to the aforementioned electrode, is made to approach the building envelope of the aforementioned electric discharge container, and is installed in the aforementioned vacuum housing. It is plasma treatment equipment equipped with the above. the aforementioned antenna of the aforementioned plasma production mechanism The 1st electrical-and-electric-equipment path section annular on the real target whose inner circumference the aforementioned power introduction aperture is surrounded and is a polygon-like, It consists of the 2nd electrical-and-electric-equipment path section which consists of two conductive rectangle boards attached in each side portion of this 1st electrical-and-electric-equipment path section on the conductive hinge. at the time of a process Area which makes perpendicular the aforementioned 2nd electrical-and-electric-equipment path section to the outside surface of the aforementioned power introduction aperture, and counters the aforementioned power introduction aperture of the aforementioned antenna is made small. at the time of cleaning It is characterized by being constituted so that area which covers the circumference of the aforementioned power introduction aperture and counters the aforementioned power introduction aperture of the aforementioned antenna by making parallel the aforementioned 2nd electrical-and-electric-equipment path section to the outside surface of the aforementioned power introduction aperture may be enlarged.

[Claim 7] Plasma treatment equipment according to claim 6 characterized by forming the cross-section configuration of the aforementioned 1st electrical-and-electric-equipment path section, and the cross-section configuration of the aforementioned 2nd electrical-and-electric-equipment path section so that the portion by the side of the aforementioned power introduction aperture may become sharp.

[Claim 8] Plasma treatment equipment given in any 1 term of the claims 1-7 characterized by preparing a magnetic field formation mechanism in the outside of the aforementioned electric discharge container so that a magnetic field may be given to the interior of the aforementioned electric discharge container.

[Claim 9] Plasma treatment equipment given in any 1 term of the claims 1-8 characterized by giving an AC bias, direct-current bias, or the bias that comes to use these together to the aforementioned electrode.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] Especially this invention uses the plasma generated by plasma developmental mechanics about plasma treatment equipment, and relates to the plasma treatment equipment mainly applied to plasma CVD and plasma etching.
[0002]
[Description of the Prior Art] With reference to drawing 26 - drawing 30 , the example of composition of conventional plasma treatment equipment is explained. This plasma treatment equipment is equipped with the cylindrical shape-like power introduction aperture 1000 and the almost annular (the shape of a loop) antenna 1001 arranged around the power introduction aperture 1000 made from the dielectric, for example, and is inductive-coupling type plasma treatment equipment. Drawing 26 shows the external view which cut and lacked this side portion of inductive-coupling type plasma treatment equipment. The detail of an antenna 1001 is shown in drawing 27 and drawing 28 .
[0003] In drawing 26 , the above-mentioned power introduction aperture 1000 has the shape of a cylindrical shape with a bore [of 362mm], and a height of 100mm. The upper limit of the power introduction aperture 1000 has conductivity, and is stopped by the electrode 1002 maintained at grounding potential. The electrode 1002 is equipped with the temperature-control mechanism which consists of a heater line 1003. The portion of an electric discharge container is formed of the power introduction aperture 1000 and an electrode 1002. This electric discharge container is arranged and fixed on the metal vacuum housing 1004. The interior of an electric discharge container and a vacuum housing 1004 is open for free passage, and, thereby, the vacuum tub is formed. The interior of a vacuum tub is decompressed by the exhaust air system (not shown) connected through exhaust-port 1004a. Reactant gas is introduced by the gas feed system which does not let pass and illustrate a part of electrode 1002 or vacuum housing 1004. The inside of a vacuum housing 1004 is maintained by the predetermined electric discharge pressure of 100Pa or less. In the state, RF power with a frequency of 13.56MHz is introduced from the power introduction aperture 1000 via the antenna 1001 of 1-fold volume which encloses an electric discharge container. By it, plasma is generated in an electric discharge container. The active species in plasma processes the front face of a substrate 1006 in which it was laid on the substrate maintenance mechanism 1005 arranged near the outlet of an electric discharge container.
[0004] An antenna 1001 is explained with reference to drawing 27 and drawing 28 . A part turns off an antenna 1001 as the electric supply section, lacks it, and it is formed annularly substantially. The cross-section configuration of an antenna 1001 is a long and slender rectangle, the antenna width of face (the length of shaft orientations, a in drawing) is 2mm, and antenna thickness (the length of the direction of a path, b in drawing) is 15mm. If RF power with a frequency of 13.56MHz is used when generating plasma using an antenna 1001, plasma will be generated based on nearly perfect inductive coupling (JP,8-203695,A). With the antenna 1001, area of the antenna portion which faces the plasma in an electric discharge container is made small. That is, antenna width of face (a) is narrowed, and it is

considering as the annular antenna of 1-fold volume. At this time, the difference of the phase angle of the antenna ends at the time of plasma production becomes about 90 degrees, and plasma production is realized by only nearly perfect inductive coupling. Moreover, plasma density also rose simultaneously. Thus, the efficient plasma production by inductive coupling becomes possible by using the antenna 1001 which made small antenna area which counters plasma, so that capacity coupling can be disregarded.
[0005]
[Problem(s) to be Solved by the Invention] When the process by plasma is generally performed in a vacuum housing 1004, a sediment is generated in the wall of a vacuum housing 1004 or an electric discharge container. For example, in etching of an oxide film, in order to use the gas of a chlorofluocarbon system, the sediment of an organic system is generated. Moreover, a film accumulates also on places other than on a substrate 1006 in a CVD process. Since these sediments cause particle in case they perform a process, they need to clean the interior, such as a vacuum housing, periodically and need to keep a container wall pure.
[0006] Generally the plasma of the cleaning gas which it reacts [gas] with a sediment and makes this evaporate is used for cleaning. Moreover, bias is impressed to the conductive portion of a vacuum housing, by irradiating the ion in plasma, the spatter of the sediment can be carried out and it can also be cleaned. Furthermore cleaning gas and impression of bias can be used together, and the cleaning speed of an electric discharge container can also be raised.
[0007] However, when the source of plasma which introduces RF power from the power introduction aperture 1000 of a dielectric using an antenna 1001 as mentioned above is used, bias cannot be impressed to the power introduction aperture 1000, and sputtering cannot remove a sediment. For this reason, depending on the cleaning time of the power introduction aperture 1000, it decides on the cleaning time in a vacuum housing 1004.
[0008] If the antenna 1007 which has a size big enough to the power introduction aperture 1000 instead of an antenna 1001 on the other hand about shaft orientations as shown in drawing 29 is used, sputtering of the power introduction aperture 1000 can be carried out (12th plasma processing study group proceedings .K Takagi et.al P433). For example, CF4 which is chlorofluocarbon system cleaning gas, using an antenna 1001 When it used and discharged for about 10 hours, the sputtering depth of a power introduction aperture was 1 micrometer or less. On the other hand, when the antenna 1007 which set antenna width of face a to 150mm was used, a sputtering depth of hundreds of micrometers or more was observed.
[0009] A negative sheath is formed in the internal surface of the power introduction aperture 1000 which antennas 1001 and 1007 have countered, the cation accelerated with this negative sheath is irradiated by the power introduction aperture, and the difference in the above-mentioned property is considered for sputtering to occur. It is thought that this sputtering was generated with the capacity produced between an antenna and the plasma in an electric discharge container. It thinks because it increased from the rate of the capacity coupling concerned at the time of using an antenna 1001 comparatively of capacity coupling in the power combination between an antenna 1007 and plasma. plasma density high as shown in drawing 30 , when an antenna 1007 is used -- it can attain (property 1007A) -- if it compares with the case (property 1001A) where an antenna 1001 is used -- the generation efficiency of plasma -- a low Therefore, if a process is performed using an antenna 1007, process speed will fall. Although what is necessary is just to switch on more RF power in order to raise plasma density, the problem that economic efficiency is not good occurs.
[0010] If the above-mentioned property is taken into consideration, in case a process is performed and it will clean using an antenna 1001, it is desirable by exchanging at an antenna 1007 to perform cleaning in an electric discharge container. However, time is needed for installation of the actual antenna 1001, the problem of the repeatability of the process depending on how to attach an antenna 1001 in exchange of an antenna 1007 and an antenna 1001, and an antenna 1007.
[0011] Moreover, in the source of inductive-coupling type plasma, usually, if electric discharge power is made to increase, inductive coupling will change from the states where capacity coupling is [the state of a plasma production mechanism] main to the main states. In the source of inductive-coupling type

plasma using the antenna of a multiplex volume, capacity coupling cleans a power introduction aperture with low electric discharge power using this, the field, i.e., the relative target, of the electric discharge power which is a main plasma production mechanism. However, for a low reason, electric discharge power has low plasma density, and there is a problem to which cleaning time becomes long.
[0012] The purpose of this invention is to solve the above-mentioned problem, in the plasma treatment equipment using the source of inductive-coupling type plasma, at a cleaning process, it carries out sputtering of the power introduction aperture efficiently, shortens cleaning time, improves plasma production efficiency at a process process, and is to offer the plasma treatment equipment which can attain a plasma process with economic sufficient efficiency.
[0013]
[Means for Solving the Problem and its Function] The plasma treatment equipment concerning this invention is constituted as follows, in order to attain the above-mentioned purpose.
[0014] The 1st plasma treatment equipment (it corresponds to a claim 1) The electric discharge container which consists of an electrode which stopped the end of a power introduction aperture and this power introduction aperture, An electric discharge container, the vacuum housing opened for free passage, and the plasma production mechanism in which plasma is generated with an electric discharge container, The exhaust air mechanism which maintains the interior of a vacuum housing at a reduced pressure state, and the gas introduction mechanism which introduces reactant gas into the interior of a vacuum housing, It is a thing equipped with the substrate maintenance mechanism which opens a predetermined interval to an electrode, is made to approach the building envelope of an electric discharge container, and is installed in a vacuum housing. the above-mentioned plasma production mechanism The 1st antenna for processes with a small antenna area fixed to the circumference of a power introduction aperture, It has the 2nd antenna for large cleaning of the antenna area prepared free [movement] to the power introduction aperture, and the 2nd antenna is separated from a power introduction aperture at the time of a process, a power introduction aperture is approached at the time of cleaning, and it is constituted so that the 1st antenna may be contacted electrically.
[0015] With the plasma treatment equipment concerning the above-mentioned this invention, as an antenna means of a plasma production mechanism The 1st antenna with a small antenna area (area which counters the power introduction aperture or plasma of an antenna), Prepare the 2nd antenna with a large antenna area, and the 2nd antenna is separated from a power introduction aperture at the time of a process. RF power was supplied using the 2nd antenna with a large antenna area by supplying RF power only with the 1st antenna with a small antenna area, and contacting the 2nd antenna at the 1st antenna at the time of cleaning.
[0016] The 2nd plasma treatment equipment (it corresponds to a claim 2) In the 1st equipment of the above, a power introduction aperture is a cylindrical shape substantially preferably. When [when the 1st antenna is substantially annular and the 2nd antenna has the annular section in a periphery side] it is a cylindrical shape-like substantially, the 2nd antenna is freely movable to the shaft orientations of a power introduction aperture further and the 2nd antenna approaches a power introduction aperture, The 2nd antenna is inserted between a power introduction aperture and the 1st antenna, and it is constituted so that the annular section may contact the 1st antenna.
[0017] The 3rd plasma treatment equipment (it corresponds to a claim 3) In the 1st equipment of the above, preferably, a power introduction aperture is a cylindrical shape substantially, and the 1st antenna is substantially annular. the 2nd antenna When it can consist of a wall which makes a big antenna area, and an outside lobe which forms the slot which holds the 1st antenna in the medial surface of this wall, and it can move in the direction of a path of a power introduction aperture freely and the 2nd antenna approaches a power introduction aperture, The 1st antenna is constituted so that it may hold in the slot of the 2nd antenna in the state of contact and a wall may counter a power introduction aperture.
[0018] The 4th plasma treatment equipment (it corresponds to a claim 4) In the 1st equipment of the above, preferably, a power introduction aperture is a semi-sphere configuration or its part substantially, and the 1st antenna is substantially annular. further the 2nd antenna When it has a semi-sphere configuration or some of its configurations substantially, and it can move in the vertical direction freely

to a power introduction aperture and the 2nd antenna approaches a power introduction aperture, the 2nd antenna covers a power introduction aperture, and it is constituted so that the part may contact the 1st antenna.
[0019] The 5th plasma treatment equipment (it corresponds to a claim 5) A vacuum housing equipped with a plate-like power introduction aperture, and the plasma production mechanism in which plasma is generated within a vacuum housing, The exhaust air mechanism which maintains the interior of a vacuum housing at a reduced pressure state, and the gas introduction mechanism which introduces reactant gas into the interior of a vacuum housing, It has the substrate maintenance mechanism which is made to approach an electric discharge field and is installed in the aforementioned vacuum housing. A plasma production mechanism has the 1st antenna and the 2nd antenna, and the 1st antenna is substantially annular. further the 2nd antenna When it can consist of the monotonous section which covers a power introduction aperture, and an outside lobe which forms the circular-sulcus section which holds the 1st antenna in the opposite side of this monotonous section, it can move in the direction which intersects perpendicularly with a power introduction aperture freely and the 2nd antenna approaches a power introduction aperture, The 1st antenna is constituted so that it may hold in the slot of the 2nd antenna in the state of contact and the monotonous section may counter a power introduction aperture.
[0020] The 6th plasma treatment equipment (it corresponds to a claim 6) The electric discharge container which consists of an electrode which stopped the end of a power introduction aperture and this power introduction aperture, An electric discharge container, the vacuum housing opened for free passage, and the plasma production mechanism equipped with the antenna which generates plasma with an electric discharge container, The exhaust air mechanism which maintains the interior of a vacuum housing at a reduced pressure state, and the gas introduction mechanism which introduces reactant gas into the interior of a vacuum housing, A predetermined interval is opened to an electrode and it has the substrate maintenance mechanism which is made to approach the building envelope of an electric discharge container, and is installed in a vacuum housing. the antenna of the above-mentioned plasma production mechanism The 1st electrical-and-electric-equipment path section annular on the real target whose inner circumference a power introduction aperture is surrounded and is a polygon-like, It consists of the 2nd electrical-and-electric-equipment path section which consists of two conductive rectangle boards attached in each side portion of this 1st electrical-and-electric-equipment path section on the conductive ginglymus. at the time of a process Area which makes perpendicular the 2nd electrical-and-electric-equipment path section to the outside surface of a power introduction aperture, and counters the power introduction aperture of an antenna is made small. at the time of cleaning It is constituted so that area which covers the circumference of a power introduction aperture and counters the power introduction aperture of an antenna by making parallel the 2nd electrical-and-electric-equipment path section to the outside surface of a power introduction aperture may be enlarged.
[0021] With the plasma treatment equipment concerning the above-mentioned this invention, the antenna means of a plasma production mechanism By consisting of the 1st electrical-and-electric-equipment path section and the 2nd electrical-and-electric-equipment path section combined with this on a ginglymus, and adjusting the position of the 2nd electrical-and-electric-equipment path section Antenna area can be changed, RF power is supplied with a gestalt with a small antenna area, and RF power was supplied using the gestalt with a large antenna area at the time of cleaning.
[0022] In the 6th equipment of the above, preferably, the 7th plasma treatment equipment (it corresponds to a claim 7) formed the cross-section configuration of the 1st electrical-and-electric-equipment path section, and the cross-section configuration of the 2nd electrical-and-electric-equipment path section so that the portion by the side of a power introduction aperture might become sharp.
[0023] The 8th plasma treatment equipment (it corresponds to a claim 8) prepared the magnetic field formation mechanism in the outside of an electric discharge container so that a magnetic field might be preferably given to the interior of an electric discharge container in the 7th equipment from the above 1st.
[0024] The 9th plasma treatment equipment (it corresponds to a claim 9) gave preferably an AC bias, direct-current bias, or the bias that comes to use these together from the above 1st to the electrode in the

equipment of the octavus.
[0025]
[Embodiments of the Invention] Below, the suitable operation gestalt of this invention is explained based on an accompanying drawing.
[0026] The 1st operation gestalt of this invention is explained with reference to drawing 1 - drawing 4 . An A-A line cross section [in / drawing 1 / in the external view of the 2nd antenna with which the external view which drawing 1 turned off some plasma treatment equipments which are in a plasma treatment state, and was lacked, and drawing 2 are used by cleaning processing, and drawing 3], and drawing 4 are the same drawings as drawing 1 which shows the arrangement state of the 2nd antenna at the time of cleaning processing.
[0027] In drawing 1 , the cylindrical shape-like power introduction aperture 12 is arranged on a vacuum housing 11. The upper limit of the power introduction aperture 12 is closed by the electrode 13, and a soffit is opened wide and leads to the interior of a vacuum housing 11. An electric discharge container is formed of the power introduction aperture 12 and an electrode 13. Inside an electric discharge container, electric discharge is caused and plasma is generated. The substrate maintenance mechanism 14 is arranged inside a vacuum housing 11, and the substrate 15 which is a processing object is laid on it. The electric discharge container and the vacuum housing 11 form the vacuum tub.
[0028] The power introduction aperture 12 is made from the dielectric which passes electromagnetic field, for example, has the shape of a cylindrical shape with a bore [of 362mm], and a height of 100mm. With this operation gestalt, the thermal shock resistance uses the strong quartz as the quality of the material of the power introduction aperture 12. The conductive electrode 13 is made from the metal and has the duty of the vacuum flange which stops the end of the power introduction aperture 12. Moreover, an electrode 13 is held at grounding potential, and the vacuum side front face is held according to the temperature-control mechanism at predetermined temperature. With this operation gestalt, it has the heater line 16 as a temperature-control mechanism, and the electrode 13 is held in temperature of about 70 degrees C or more by the heater line 16.
[0029] Although illustration of a gas feed system was omitted with the operation gestalt of drawing 1 , to an electrode 13, it is also possible to prepare a shower head-like gas exit cone.
[0030] In a vacuum housing 11, a substrate 15 is processed by the plasma diffused from an electric discharge container. The interior of a vacuum housing 11 is exhausted by the exhaust air system which is not illustrated through an exhaust port 17, and is held at the required vacua. Although a vacuum housing 11 is an airtight container in fact, drawing 1 opens wide and shows the lower part for convenience. The vacuum housing 11 is usually formed by the metallic material.
[0031] Around the power introduction aperture 12, the annular (it has a notch in part) antenna 18 is arranged substantially. In the case of processes, such as membrane formation, an antenna 18 is a means for supplying RF power required in an electric discharge container, and, below, is called "1st antenna." The 1st antenna 18 is connected to the power introduction mechanism (power supply) which is not illustrated. The 1st antenna 18 has the same gestalt substantially with the conventional antenna 1001 explained with reference to drawing 26 . The 1st antenna 18 is an annular antenna flat as the whole, it has desired small antenna width of face, makes the edge of the inside counter the power introduction aperture 12, and is arranged. A bore is [380mm and the outer diameter of the 1st antenna 18] 410mm. As for the arrangement position of the height direction of the 1st antenna 18, in the length of the shaft orientations of the power introduction aperture 12, it is desirable that it is a center position mostly.
[0032] The plasma treatment equipment which has the above-mentioned composition operates as follows. The interior of a vacuum housing 11 is exhausted by the attached exhaust air system, and is made into a predetermined vacua. Then, reactant gas is introduced in an electric discharge container by the gas feed system which is not illustrated, and evacuation is simultaneously carried out by the exhaust air system, for example, a predetermined **** state 100Pa or less is maintained. According to the power introduction mechanism which furthermore is not illustrated, RF power is introduced in an electric discharge container via the 1st antenna 18 and the power introduction aperture 12, and plasma is generated in the electric discharge container concerned. RF power activates the particle of reactant gas

and generates plasma. A substrate 15 is held on the substrate maintenance mechanism 14 installed in the form which counters an electrode 13, the interior of an electric discharge container is faced the front face of the substrate concerned, and it is processed by the active species in the plasma generated within the electric discharge container. In this way, a process process is performed.

[0033] In the above-mentioned plasma treatment equipment, it is the circumference of an electrode 13 and other antennas 19 are arranged at the upper part side of an electric discharge container. This antenna 19 is an antenna used in the case of the cleaning process after a process process, and, below, is called "2nd antenna." At the process process of plasma treatment, the 2nd antenna 19 is arranged so that the soffit may become an upper part position from an electrode 13.

[0034] With reference to drawing 2 , the 2nd antenna 19 is explained in full detail. The 2nd antenna 19 is a substantial cylinder with which a bore has 375mm and an outer diameter has 378mm and a size with a height of 80mm. Conductive annulus ring section 19a is attached in the center-section periphery of the height direction of the body of the 2nd antenna 19. A part of body of the 2nd antenna 19 is cut and lacked. The 2nd antenna 19 is arranged so that a notch may be in agreement with the electric supply section of the 1st antenna 18. The 2nd antenna 19 is supported by the insulated supporter (not shown), is arranged above an electric discharge container, and is moved to the shaft orientations of the power introduction aperture 12 by the drive section (not shown).

[0035] The 2nd above-mentioned antenna 19 can be formed in the circumference of the power introduction aperture 12 free [vertical movement], can be further inserted in the space between the power introduction aperture 12 and the 1st antenna 18 from the upper part, and can contact annulus ring section 19a at the 1st antenna 18 further. When the 2nd antenna 19 is contacted at the 1st antenna 18 through annulus ring section 19a, the 2nd antenna 19 becomes the 1st antenna 18 and this potential.

[0036] With reference to drawing 3 and drawing 4, two kinds of use modes (arrangement position) of the 2nd antenna 19 are shown. At the process process, as shown in drawing 3 , the 2nd antenna 19 is drawn out from the space between the 1st antenna 18 and the power introduction aperture 12, and the soffit of the 2nd antenna 19 is moving it above an electrode 13. In this state, since the 1st antenna 18 with a small area which counters plasma (or power introduction aperture) turns into main antennas, efficient generation of plasma is performed inside an electric discharge container by the plasma production mechanism in which inductive coupling of the 1st antenna 18 is dominant. On the other hand, at the cleaning process which cleans the inside of an electric discharge container, as shown in drawing 4 , the 2nd antenna 19 is inserted in the space between the power introduction aperture 12 and the 1st antenna 18, the 1st antenna 18 and the 2nd antenna 19 are contacted, and two antennas serve as one-structure electrically. At this time, the upper limit and soffit of the 2nd antenna 19 made the arrangement position of the 2nd antenna 19 the position distant from each of an electrode 13 and a vacuum housing 11 10mm with this operation gestalt. In addition, the width of face (the length of shaft orientations) of the 2nd antenna 19 is determined by electric discharge power etc., and is maintained at the interval which air electric discharge does not generate between the electrodes 13 and vacuum housings 11 which are grounding potential. By the above composition, it becomes possible by inserting the 2nd antenna 19 between the 1st antenna 18 and a power introduction aperture at the time of cleaning to make the area of the antenna which counters plasma increase substantially. Thereby, the capacity between plasma and an antenna increases, becomes possible [forming the negative sheath of the almost big potential difference all over a wall of the power introduction aperture 12], carries out the spatter of the whole simultaneously surface of the power introduction aperture 12, and can clean it efficiently.

[0037] Next, with reference to drawing 5 and drawing 6 , an example of the supporter of the 2nd antenna 19 and the drive section is explained. In drawing 5 and drawing 6 , the supporter and the drive section of the 2nd antenna 19 are added to the composition shown in drawing 1 . In drawing 5 , drawing 6 shows the time of a cleaning process at the time of the process process of plasma treatment. The 2nd antenna 19 is attached in the insulating supporter 21 connected to the cylinder 20. When a cylinder 20 operates, the 2nd antenna 19 can be moved in the direction of the medial axis of an electric discharge container. During plasma treatment, a cylinder 20 moves the 2nd antenna 19 above an electrode 13. During cleaning, a cylinder 20 pushes the 2nd antenna 19 against the 1st antenna 18, and moves it to the

position in which electric contact is possible. In addition, the drive of a cylinder 20 consists of control [be / electric / pneumatics-oil pressure-/ it].
[0038] Plasma is efficiently generated because the power combination between an antenna and plasma is mainly concerned with inductive coupling during plasma treatment using the 1st antenna 18 with the above-mentioned operation gestalt so that clearly. Moreover, in case cleaning in an electric discharge container is performed, the power introduction aperture 12 can be cleaned by sputtering according to connecting the 2nd antenna 19 and the 1st antenna 18 electrically, considering as integral construction, and the power combination between an antenna and plasma being mainly concerned with capacity coupling. Thereby, it is compatible in time shortening of plasma treatment, and shortening of the cleaning time in an electric discharge container.
[0039] In addition, although the 2nd antenna 19 was considered as one composition with this operation gestalt, the 2nd antenna can also consist of combination of two or more cylinders.
[0040] Next, with reference to drawing 7 - drawing 9 , the example of the source of inductive-coupling type plasma which made the magnetic field in the electric discharge container is explained. The composition of the operation gestalt mentioned above is effective also to the source of plasma which impresses a magnetic field in an electric discharge container. the permanent magnet 22 disc-like or in a circle with which drawing 7 differs in a radius in the atmosphere side of an electrode 13 -- the plasma treatment equipment which has arranged a-22d in concentric circle is shown According to this composition, the magnetic field is impressed in an electric discharge container from the bottom through an electrode 13. Drawing 8 shows plasma treatment equipment equipped with the electromagnet 23 arranged so that an electric discharge container may be surrounded. According to this composition, the magnetic field is impressed to the whole interior of an electric discharge container. Drawing 9 shows the plasma treatment equipment with which the permanent magnets 24a and 24b in a circle to the upper and lower sides of the 1st antenna 18 have been arranged. The magnetic field is impressed in an electric discharge container from the side through this composition ****** and the power introduction aperture 12. However, conductive annulus ring section 19b fixed to the periphery center section of the 2nd antenna 19 in this case has an outer diameter smaller than the above-mentioned annulus ring section 19a, and has the structure where the inside of permanent magnet 24a in a circle can be passed. By drawing 7 - drawing 9 , the composition of those other than the mechanism in which a magnetic field is generated is the same as the composition of the above-mentioned operation gestalt, and gives the same sign to the same element substantially.
[0041] Moreover, although the following operation gestalten do not show the mechanism in which a magnetic field is given, it is also possible to establish the mechanism in which a magnetic field is given as well as the above-mentioned operation gestalt.
[0042] The 2nd operation gestalt of this invention is explained with reference to drawing 10 - drawing 13 . The external view which drawing 10 turned off some plasma treatment equipments which are in a plasma treatment state, and was lacked, the plan of an electric discharge container portion in which drawing 11 shows the state of the 2nd antenna at the time of a process process, the plan of an electric discharge container portion in which drawing 12 shows the state of the 2nd antenna at the time of a cleaning process, and drawing 13 are the B-B line cross sections in drawing 12 . In each drawing, the same sign is substantially given to the same element with the element explained with the 1st operation gestalt.
[0043] With this operation gestalt, as shown in drawing 10 and drawing 11 , the 2nd two antenna 31 is arranged around [outside] the 1st antenna 18 with the cylindrical electric discharge container which equips the circumference of the power introduction aperture 12 with the 1st antenna 18. The 2nd two antenna 31 arranged in the position on either side has the same structure so that clearly from drawing 11 . The 2nd antenna 31 consists of partial (henceforth "half-soma") 31a carried out 2 ****s, such two half-somata 31a is combined on a ginglymus 32, and it has the structure which can be opened and closed freely like the scissors of a crab. Each half-soma 31a of the 2nd antenna 31 on either side is individually equipped with a cylinder 33 in the illustrated physical relationship. Each ****** 31a is combined at the nose of cam of movable shaft 33a of the corresponding cylinder 33. In addition, the point 34 of movable

shaft 33a is an insulating supporter. It operates pneumatics-wise [a cylinder 33], oil pressure-wise, or electrically, and the operation is controlled by the controlling mechanism (not shown).
[0044] If all the cylinders 33 operate simultaneously and retreat the movable shaft 33a, as shown in drawing 11 , it was pulled outside, and moved outside as the 2nd whole antenna, and each ****** 31a of the 2nd two antenna 31 on either side will be opened around a ginglymus 32. Only a required distance will be separated from the 1st antenna 18 by the 2nd antenna 31 at this time. Moreover, if all the cylinders 33 operate simultaneously and make the movable shaft 33a project to the front, as shown in drawing 12 and drawing 13 , it was pushed inside, and moved inside as the 2nd whole antenna, and each ****** 31a of the 2nd two antenna 31 on either side will be closed around a ginglymus 32. At this time, after wall 31b equivalent to a part of body explained with the 1st operation gestalt has approached the superficies of the power introduction aperture 12, the 2nd antenna 31 is arranged, while it contacts the rim of the 1st antenna 18 and becomes integral construction, as shown in drawing 13 .
[0045] Here, if the structure of the 2nd antenna 31 is explained, the 2nd antenna 31 will consist of wall 31b and **** lobe 31c projected to the method of outside in the center of the superficies. As shown in drawing 13 , wall 31b has predetermined width of face in the shaft orientations of an electric discharge container, and is curving in accordance with the superficies of the power introduction aperture 12. Therefore, as shown in drawing 13 , when it is in the state where the 2nd antenna 31 on either side closed, the portion which is equivalent to the body of the 2nd antenna 19 explained with the 1st operation gestalt with wall 31b of the 2nd antenna 31 on either side is formed in the circumference of the power introduction aperture 12. Moreover, **** lobe 31c is formed along with the longitudinal direction (circumferencial direction) of straight wall 31b. Of **** lobe 31c, 31d of slots is formed in the medial surface of wall 31b at a circumferencial direction so that clearly from the cross-section configuration of drawing 13 . When closed by the 2nd antenna 31, 31d of slots serves as a space in which the 1st antenna 18 is held. The 1st antenna 18 held in 31d of slots formed inside **** lobe 31c touches **** lobe 31c by the rim.
[0046] Drawing 11 shows the state of a process process. In this case, the 2nd antenna 31 is in the state where it separated from the power introduction aperture 12, and only the 1st antenna 18 is used as an electric power supply means. Drawing 12 and drawing 13 show the state of a cleaning process. During cleaning, in an operation of a cylinder 33, the 2nd antenna 31 is mechanically pushed from the periphery side of the 1st antenna 18 at the same time it puts the 1st antenna 18. The 2nd antenna 31 serves as the same potential as the 1st antenna 18. By the above composition, since the 2nd antenna 31 can make small distance between the power introduction apertures 12 in the case of cleaning and antenna area can be increased by wall 31b, the capacity between plasma and an antenna increases. Consequently, the spatter of the whole simultaneously surface of the wall of the power introduction aperture 12 can be carried out. Therefore, the area of the antenna which counters the plasma under cleaning is increased, and the same effect as the 1st operation gestalt can be attained.
[0047] In addition, with the 1st and 2nd operation gestalt, at the time of cleaning, the 2nd antenna is contacted at the 1st antenna, and the area to the plasma of an antenna is increased by considering as integral construction electrically at it.
[0048] Next, the 3rd operation gestalt of this invention is explained with reference to drawing 14 - drawing 17 . It was made to increase antenna area with the above-mentioned operation gestalt using the combination of the 1st antenna and the 2nd antenna at the time of a cleaning process. To this, with the 3rd operation gestalt, only a single antenna is used and it makes it possible structurally to increase the area to the plasma of an antenna only by deformation of an antenna at the time of a cleaning process. It is a D-D line cross section [in / drawing 16 / the external view and drawing 15 which show the state of the antenna / drawing 14 / at the time of the process process of plasma treatment the C-C line cross section in drawing 14 , and drawing 16 , and / in drawing 17]. / the external view of the antenna at the time of the cleaning process of an electric discharge container Although the composition of the power introduction aperture mentioned above, an electrode, a vacuum housing, etc. is omitted in each above drawing, these composition is the same also with this operation gestalt. By drawing 14 and drawing 16 , the amount of [which was shown with the dashed line] body is equivalent to the above-mentioned

power introduction aperture 12. Physical relationship, an antenna and the power introduction aperture 12, i.e., an electric discharge container, according to this operation gestalt by this, is clear.
[0049] The antenna 40 concerning this operation gestalt is annular as a whole, and an inner circumference configuration consists of the electric path section 41 of the shape of one layer which is eight square shapes, and two or more electric path sections 401-408 which it is crowded on both sides of this electric path section 41 from the upper and lower sides, is arranged corresponding to each **** of the electric path section concerned, and are rectangles, and are conductivity. Hereafter, the electric path section 41 is called 1st electrical-and-electric-equipment path section, and the electric path sections 401-408 are called 2nd electrical-and-electric-equipment path section. Desirable substantial thickness is 3mm or less in tabular, a part of circumferencial direction cuts and lacks the 1st electrical-and-electric-equipment path section 41, and it supplies the position cut and lacked to this power. Two each of the 2nd electrical-and-electric-equipment path sections 401-408 is arranged at each (401a, 401b-408a, 408b) upper-and-lower-sides side of each **** of the 1st electrical-and-electric-equipment path section 41 of eight square shapes, respectively. Each portion of two sheets of the 2nd electrical-and-electric-equipment path sections 401-408 is connected to the inner circumference edge of the 1st electrical-and-electric-equipment path section 41 through a ginglymus 42. It has flowed through the 1st electrical-and-electric-equipment path section and the 2nd electrical-and-electric-equipment path section electrically.
[0050] The portions 401a and 401b of the upper and lower sides of the 2nd electrical-and-electric-equipment path section 401-408, --, 408a and 408b can be freely opened and closed around a ginglymus 42. A part for a part for the upper part of the vertical side of the 1st electrical-and-electric-equipment path section 41 and the 2nd electrical-and-electric-equipment path sections 401-408 and the lower part can be rotated around a ginglymus 42 in [angle] 0-90 degrees. Under the present circumstances, operation of the 2nd electrical-and-electric-equipment path sections 401-408 is performed by the mechanical composition insulated in the antenna 40 as explained by the 1st and 2nd operation gestalten. In drawing of this operation gestalt, the mechanical composition concerned is omitting illustration.
[0051] As shown in drawing 15 , with the gestalt of the antenna 40 in the process process under plasma treatment, the 1st electrical-and-electric-equipment path section 41 and the 2nd electrical-and-electric-equipment path sections 401-408 are connected on the conductive ginglymus 42, and the angle between the vertical side of the 1st electrical-and-electric-equipment path section 41 and the vertical section of the 2nd electrical-and-electric-equipment path sections 401-408 is about 0 degree mostly. It is possible to be able to realize by this the antenna 40 which is mainly concerned with inductive coupling during plasma treatment, and to set up an antenna 40 as a plasma production mechanism.
[0052] The state of the antenna 40 in a cleaning process is shown in drawing 16 and drawing 17 . With the gestalt of the antenna 40 in a cleaning process, the angle between the vertical side of the 1st electrical-and-electric-equipment path section 41 and the 2nd electrical-and-electric-equipment path sections 401-408 becomes about 90 degrees. It can enlarge, while this cleans the area (antenna area) of the antenna 40 which counters the plasma in an electric discharge container. Under the present circumstances, the height of an antenna 40, i.e., the length of shaft orientations, is made shorter than the height of the power introduction aperture 12, and it is made into the grade which air electric discharge does not generate between an electrode 13 and an antenna 40. By the above, it becomes possible by using an antenna 40 to make the antenna area which makes small antenna area which counters plasma during plasma treatment, is cleaning, and counters plasma with the antenna which has single structure increase. In this way, one antenna 40 can attain the same effect as the 1st and 2nd operation gestalten.
[0053] It is [0054] which can also be made into the shape of a polygon with the arbitrary configuration of an inner circumference edge although the configuration of the inner circumference edge of an antenna 40 was made into eight square shapes with the above-mentioned operation form. The composition of the 3rd operation form can also deform again, as shown in drawing 18 - drawing 20 . It is drawing in which drawing and drawing 19 which drawing 18 is equivalent to above-mentioned drawing 14 , and show the antenna state at the time of a process process show the E-E line cross section in drawing 18 , and drawing 20 shows the antenna state at the time of a cleaning process. With the above-mentioned 3rd operation form, the feature is that makes the inner periphery side concerned of the 1st electrical-and-

electric-equipment path section 51 the configuration of an acute angle, and it is making it into the acute angle shape of a wedge, and the ** (jeering) configuration in the overall cross-section configuration of an antenna 50 by this operation form to having made the inner periphery side of the 1st electrical-and-electric-equipment path section into the rectangle. By making an antenna into this configuration, the antenna side which counters the plasma in an electric discharge container can be made small, and the plasma production efficiency in a process can be raised. As for an antenna 50, an inner circumference edge consists of the 1st electrical-and-electric-equipment path section 51 and the 2nd electrical-and-electric-equipment path sections 501-508 of eight square shapes. Each of the 2nd electrical-and-electric-equipment path sections 501-508 consists of up-and-down portions 501a and 501b, --, 508a and 508b, and it is combined with the 1st electrical-and-electric-equipment path section 51 so that opening and closing may become free through a hinge 52. These composition is the same as the composition of the 3rd operation form mentioned above. The cross section of an up-and-down portion has become wedge-like, and the cross-section configuration of an antenna 50 is made to form in a wedge as a whole with the 1st electrical-and-electric-equipment path section, as the feature of the 2nd electrical-and-electric-equipment path section is shown in drawing 19 .

[0055] Moreover, as shown in drawing 20 , during cleaning, the portion of the upper and lower sides of the 2nd electrical-and-electric-equipment path section 501-508 becomes about 90 degrees to the 1st electrical-and-electric-equipment path section 51. The power introduction aperture 12 of an electric discharge container can be covered from a periphery side by this, and it is possible to enlarge during cleaning area of the antenna 50 which counters plasma. Therefore, at the time of cleaning, the same effect as the 3rd operation gestalt is expectable.

[0056] Next, the 4th operation gestalt of this invention is explained with reference to drawing 21 - drawing 23 . This operation gestalt shows the example applied to the power introduction aperture which used a part of semi-sphere. In drawing 21 , the external view of the electric discharge container portion under plasma treatment and drawing 22 show the external view of the 2nd antenna, and drawing 23 shows the external view of the electric discharge container portion under cleaning.

[0057] As shown in drawing 21 , an electrode 62 is formed on the power introduction aperture 61 formed using some semi-sphere-like dielectrics, and the electric discharge container is formed. This electric discharge container is arranged at the vacuum housing 11 explained with the above-mentioned operation gestalt, and forms a vacuum tub as a whole. The 1st antenna 63 of the single volume of a flat configuration of the height direction of the outside of the power introduction aperture 61 with which the longitudinal direction of a cross section becomes perpendicular to the outside front face of the power introduction aperture 61 in the center mostly is arranged. The 2nd antenna 64 used at the time of cleaning is supported by the insulator supporter which is not illustrated, is arranged above the electric discharge container, and is formed free [movement] by the drive which is not illustrated in the direction of a medial axis of an electric discharge container.

[0058] As shown in drawing 22 , the configuration of the 2nd antenna 64 covers and covers the power introduction aperture 61, and has turned into the shape of a part of semi-sphere which meets the power introduction aperture 61. However, it becomes depressed near the position in contact with the 1st antenna 63 of the 2nd antenna 64 outside, and it is formed in the shape of a slot, and it is the configuration which the 2nd antenna 64 and the 1st antenna 63 contact at the same time the portion used as the shape of a semi-sphere of the 2nd antenna 64 approaches the power introduction aperture 61, when the 2nd antenna 64 covered and covers an electric discharge container. The portion which hits the electric supply section of the 1st antenna 63 of the 2nd antenna 64 is cut and lacked in radial.

[0059] At the time of the process process of plasma treatment, as shown in drawing 21 , it considers as the state where it separated from the power introduction aperture 61, and the 1st antenna 63 is used, and thereby, the 2nd antenna 64 is making area to the plasma of an antenna into the minimum during plasma treatment, and performs efficient plasma production.

[0060] At the time of the process which cleans an electric discharge container wall, the 2nd antenna 64 is made to approach the power introduction aperture 61, and the 2nd antenna 64 and the 1st antenna 63 are contacted, and let the 1st antenna 63 and the 2nd antenna 64 be integral construction electrically.

Consequently, the antenna area to plasma increases and power combination between plasma and an antenna can be made into the plasma production mechanism mainly concerned with capacity coupling. Thereby, the power introduction aperture 61 can be efficiently cleaned by sputtering. The same effect as the operation gestalt mentioned above is applicable also to a semi-sphere-like power introduction aperture.

[0061] Next, the 5th operation form of this invention is explained with reference to drawing 24 and drawing 25 . This operation form shows the example which applied this invention to the plasma treatment equipment using the plate-like power introduction aperture. The external view and drawing 25 which drawing 24 turned off some of 2nd antennas and plasma treatment equipments under plasma treatment, and were lacked are drawing of longitudinal section of the plasma treatment equipment under cleaning. In each drawing, the same sign is substantially given to the same element with the element explained with the above-mentioned operation form.

[0062] As shown in drawing 24 , it inserts in the upper wall portion of a vacuum housing 11, and is fixed by the formula, and the disc-like power introduction aperture 71 forms the upper wall of a vacuum housing 11. The antenna 72 of a single volume is arranged at the atmosphere side which is the outside of the power introduction aperture 71. The antenna 72 is incurvating the thing of a ribbon base annularly. The part is open and forms the electric supply section. In the vacuum housing 11, the power introduction aperture 71 is countered and the substrate maintenance mechanism 14 is arranged. Moreover, the heater line 73 is formed in the vacuum housing 11. Other composition is substantially [as the above-mentioned operation form] the same.

[0063] The above-mentioned antenna 72 supplies the RF power for generating plasma in a vacuum housing 11 via the power introduction aperture 71, when it is equivalent to the 1st above-mentioned antenna and plasma treatment of the substrate 15 is carried out. With the composition of this operation gestalt, a vacuum housing 11 is used also as an electric discharge container. The above-mentioned antenna 72 is the 1st antenna used at a process process.

[0064] The 2nd antenna 74 for cleaning is formed to the 1st above-mentioned antenna 72. As shown in drawing 24 , the 2nd antenna 74 is a part by the side of the atmosphere of the power introduction aperture 71, and is supported free [movement in the vertical direction]. It is the state which showed in drawing 24 at the process process time, and the 2nd antenna 74 is separated from the power introduction aperture 71, and the 1st antenna 72 fixed to the power introduction aperture 71 is arranged. Since the 1st antenna 72 is in the state where it stood to the power introduction aperture 71 and antenna area is small so that clearly from drawing, it is possible to perform efficient plasma treatment according to the plasma production mechanism mainly concerned with inductive coupling.

[0065] Moreover, the 2nd antenna 74 has annular lobe 74c for forming almost annular slot 74b which can hold the 1st antenna 72 in the field which has disk-like monotonous section 74a into the portion near the power introduction aperture 71, and counters the power introduction aperture 71 of monotonous section 74a. Moreover, slit 74d is formed corresponding to the notch of the 1st antenna 72. Although monotonous section 74a has a diameter smaller than the diameter of the power introduction aperture 71, it has the latus area (antenna area) which is the grade which can, on the whole, cover the power introduction aperture 71.

[0066] If the 2nd antenna 74 approaches the power introduction aperture 71, simultaneously, the 1st antenna 72 and the 2nd antenna 74 will contact, and two antennas will serve as integral construction electrically. Under the present circumstances, the soffit side of monotonous section 74a which goes to the power introduction aperture 71, and the inferior surface of tongue of the 1st antenna 72 can be made into a size mostly in agreement, can shorten distance of the plasma under cleaning, and the 2nd antenna 74, and can enlarge capacity between plasma and the 2nd antenna 74. moreover, the above-mentioned slit 74d -- the number of width of face -- it is about 10mm and is formed from the periphery section of the 2nd antenna 74 to near a center Slit 74d, it is arranged so that it may be in agreement between the points of the 1st antenna 72 introducing [power] in the case of cleaning. It has prevented the flowing current concentrating the 2nd antenna 74 between the points introducing [power] by this.

[0067] As shown in drawing 25 , at the time of cleaning of the wall of the electric discharge field of a

vacuum housing 11, the 2nd antenna 74 is made to approach the power introduction aperture 71, and the 2nd antenna 74 and the 1st antenna 72 are contacted. Consequently, the antenna area to plasma increases and the power combination between plasma and an antenna serves as a plasma production mechanism mainly concerned with capacity coupling. Thereby, the power introduction aperture 71 can be efficiently cleaned by sputtering. According to this composition, cleaning of the power introduction aperture 71 of a plane as well as each above-mentioned operation gestalt can be performed.

[0068] Although the above operation gestalt showed the example of the source of inductive-coupling type plasma which used the annular antenna of 1-fold volume, it is applicable also to the source of plasma using the annular antenna of a multiplex volume. Moreover, direct-current bias, an AC bias, or the mechanism in which use these together and bias is impressed can also be established to an electrode. The front face of an electrode can always be kept pure by such bias.

[0069] Although the operation gestalt of this invention showed the example which used the power introduction aperture of the shape of the shape of a cylinder, and a semi-sphere, it cannot be overemphasized that it can apply also to the electric discharge container used as the polygon-like cylinder.

[0070]

[Effect of the Invention] By according to this invention, using two antennas or improving the composition of a single antenna so that clearly from the above explanation During plasma treatment, area (antenna area) which counters the plasma of an antenna is made small. inductive coupling that it is main by the power combination between an antenna and plasma by the bird clapper In case plasma is generated efficiently and cleaning in another side and an electric discharge container is performed, capacity coupling can clean a power introduction aperture by sputtering by the power combination between an antenna and plasma by increasing antenna area at a bird clapper as it is main. This becomes possible to be compatible in time shortening of plasma treatment, and shortening of the cleaning time in an electric discharge container.

[Translation done.]